SAVONIA

FINLAND'S CLEANTECH BUSINESS POSSIBILITIES FOR QATAR 2022 WORLD CUP

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Master's Thesis

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Abstract

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Abstract

The aim of this thesis was to study and analyse cleantech Finland investment possibilities for Qatar 2022 FIFA World Cup and beyond by advocating best examples of cleantech Finland solutions to Qatar.

Cleantech Finland with energy and environmental technology as one of the focal areas is ranked among the top in the globe and has had success stories offering different solutions in many countries. The sector has created new international business opportunities but still there is a lot to offer and countries like Qatar can be a new destination to promote cleantech Finland solutions.

Qatar is ranked as the richest country in World creating big profits from the oil and gas production, but also working fast to diverse its business sector and not depends only on oil and gas. The country will host the 2022 FIFA World Cup plus it has its own 2030 National Vision plan to transform the country into an advanced location within the region. To achieve these mega plans Qatar has made it clear there is a need for international investment.

This research which was based on data collection from different literature is to introduce different cleantech Finland solutions available. It was highlighted some companies and their business areas to match them with the available investments opportunities during Qatar World Cup preparation to build mega constructions including stadiums, hotels, roads and airports. The research also addressed approaches to create networking for building relations and how to sustain cleantech business operations by building trustful relations.

Keywords
Cleantech, energy generation, green buildings, innovation, business networking.

ACKNOWLEDGEMENTS

My motivation to carry a business cooperation research work between Qatar and Finland has started since my visit to Qatar in 2012 where I had the chance to discuss with friends, the public and some officials. What I have noticed there was a general admiration and interest in Finland as an advanced country in education, technology and cleanliness. Also I have noticed the significant efforts Qatar had made to transfer itself to an advanced country within the region facilitating its wealth to be invested in different areas hosting foreign companies to be engaged in the country's transformation process. I thought the experiences of Finland can be shared through cooperation and cleantech is the best sector. I discussed the idea with my principal lecturer Mr. Jarmo Pyysalo and he did approve it.

I would like to have the opportunity to thank my supervisor and senior lecturer Mr. Jarmo Pyysalo for the support and guidance.

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Oulu, Finland, December 2015

Mustafa Ibrahim Ali

ABBREVIATIONS

CIGS (Copper Indium Gallium Selenide); 14
CLEANTECH; 13
CTG (Cleantech Group).; 28
DigiEcoCity (Digital Ecological City); 41
GCCA (Global Cleantech Cluster Association's); 28
GDP (gross domestic product); 23
GHG (greenhouse gas); 26
GSM; 18
GTL (gas-to-liquid); 39
HPR (High Performance Renewable); 44
LNG (liquefied natural gas); 22
PPP (purchasing power parity); 23
QBRI (The Qatar Biomedical Research Institute); 34
QCRI (Qatar Computing Research Institute); 34
QFC (Qatar Financial Centre); 25
QGBC (Qatar Green Building Council); 31
QNRF (Qatar National Research Fund); 33
QSTP (Qatar Science and Technology Park); 25, 33
SRF (solid recovered fuel); 43

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1 INTRODUCTION

This master thesis is an intensive and accomplished research supposed to analysis cleantech Finland, their solutions and promotes them to Qatar 2022 FIFA World Cup.
The aim was to promote the best cleantech solutions by identifying experienced companies in the sector to highlight the best solutions both in Finland and abroad, then to identify the possible cleantech opportunities in Qatar and to match them with the possible solutions what cleantech Finland can offer by establishing business networking and communication approaches.

Qatar invests in different areas aiming to transform itself into advanced location within the region attracting the best companies to enter one of the fastest growing markets in the world. The country has reserved a huge budget to produce a successful 2022 FIFA World Cup and achieve its National Vision 2030 goals. Many international universities have established branches, research centres in the country. Huge mega constructions projects have been started and more are in the pipeline. At the same time the environmental sustainable solutions have been set as top priorities and the country is looking for best cleantech solutions to be adopted within its mega projects plans.

Cleantech Finland sector is well recognized and its expertise is in high demand globally. I thought this sector will be a good area to be promoted in Qatar because it's not only generating profits but it's also to share the experiences of having real solutions to the alarming global environmental problems which are involving public, business, educational institutions and research centres.

The aim of this thesis is to bring Qatar's demand for best solutions and Finland's best cleantech solutions together by highlighting the investment opportunities in Qatar and promoting the best product, services available within Finland's cleantech industry by creating references and sources of networking to ease cooperation, experiences sharing and knowledge transfer in environmental solutions.

Chapter 2 identifies the objective of the research and the goals to be achieved. Chapter 3 introduces cleantech as technology with benefits and different areas where it is applied to have sustainable environmental solutions, to organize the use of natural resources and generate profits through commercialization which will help in community socioeconomical development and enhance the research and development in the cleantech sector. Chapter 4 highlights cleantech Finland as a sector. The main areas

that drive the sector in different activities and their strategies to draw a map for priorities by having different actions, Chapter 5 discusses the encouraging environments for investment and opportunities in Qatar, incentives for foreign investment, establishment of legal representation, and utility of cleantech to balance the economical rise and environmental impacts in Qatar. Chapter 6 introduces the mega projects for the 2022 FIFA World Cup and Qatar National Vision 2030, and investmnet opportunities avaialble. Chapter 7 discusses cleantech Finland export strategies. The chapter also discusses the competition within the investmnet in Qatar and highlights Finland global index top ranking in many areas and what role does the ranking reputation play in cleantech Finland promaton to Qatar, also the Chapter highlighs the best solutions for cleantech Finland globally to promote the best success stories and advocate the best product and solutions. Chapter 8 concludes the research and highlights the encouraging results to plan and create networks of informations to help initiate processes of building business relations. The research concludes there is a great need for investment in Qatar and the companies should move fast to this attractive business opportunirty.

2 OBJECTIVE

The objective of this thesis is to promote different Cleantech Finland products and services in Qatar during the 2022 FIFA World Cup event and beyond. It's aimed to help Finnish cleantech companies to advocate their latest products and services within the sector by starting to communicate with different players like Qatar cleantech companies, service providers and those who are looking for best solutions in different areas within the cleantech sector.

2.1 Goals

By surveying the needs for cleantech in Qatar during the 2022 FIFA World Cup and beyond, introducing the best solutions of cleantech Finland and presenting the results the following goals are to be achieved.

- Introducing the cutting edge technological innovations of Finnish cleantech industry knowhow especially to Qatar.
- Creating business opportunities to Qatar public and private sectors, by utilizing the Finnish Cleantech industry experiences.
- To develop sustainable solutions for the main pillars like energy, environment and health which are leading the science and research mission in Qatar.
- Promoting the newest cleantech technologies in waste management, water management and air-conditioning as main challenges of the most World Cup events.
- Building cooperation and collaboration between Qatar and Finland through knowledge and experience sharing.
- Creating business opportunities for cleantech Finland sector in Qatar and other Gulf countries.
- Creating research opportunities between the two countries' institutions and industries through staff training, expert visits and students' exchange.
- Easing the cooperation between Qatar and Finland in business operation and commerce.
- Helping in building Qatar industry by utilizing the Finnish knowhow in different areas.

Achieving the above goals cleantech industries the both countries will benefit. This will not only create business opportunities but also transfer the knowledge between the two countries.

This thesis has identified a number of Finnish cleantech companies and also highlighted the main areas where it is possible to invest. The work can be used as a reference which can be compiled to other existing materials to achieve the goal.

2.2 Thesis motivation

Qatar has small size, but a big political and economic weight. It's also a major humanitarian aid donor which increased the country's fame.

To share this wealth the country are inviting foreign companies to explore the local market in all business areas not just from benefit prospective, but also as a mean of accelerating the changes in the country emerging as advanced location in the region. Innovation is highly promoted in Qatar especially among young people, encouraging them not to be afraid to take risk, but be creative and open minded, and not copy other systems but to take the best examples and incorporate them into a local model hoping to advocate Qatar as a world class country in many areas.

Qatar is hosting FIFA world cup in 2022 and planning huge construction activities to accommodate this event. There are many issues within cleantech to be addressed like energy efficiency, waste management, air-cooling, green buildings and water management.

Cleantech Finland has advanced technical solutions and in this work I am advocating the investment opportunities for cleantech Finland to export its excellent solutions to Qatar during the FIFA 2022 event and beyond.

Using my academic and work experiences plus my cultural background I am planning to find different cleantech companies, consumers, investors, institutions, industries, research centres and local authorities in Qatar and then advocate the best Finnish cleantech industries and their solutions especially for Qatar 2022 FIFA World Cub event. My aim is to continue this work by visiting different Finnish cleantech companies and analysing their capacity and share my findings which will help to promote this sector in Qatar.

3 CLEANTECH

Cleantech or clean technology is a diverse range of products, services and process to provide alternative means of resources to save environment by advocating the reuse of renewable materials and energy sources to reduce the use of natural resources, eliminate waste and emissions to have less environmental damage and better economic competitiveness.

Recycling is a central process operation in cleantech, because it's the way to assess the overall resources usages and control environment damage. The privilege goal of cleantech is to prevent the nature from pollution by reducing waste, through innovative recycling processes and new recyclable materials.

3.1 Cleantech benefits

Cleantech is not only a business to generate income and profits, it's about product design improvement to create less environmental problems while providing fundamental services and deliver a lot of benefits such as:

- Provide relief to shortages in energy, water, and other natural resources
- Reduce greenhouse gas emissions
- Prevent from deforestation
- Decrease air and water pollution
- Save from resource scarcity
- Reduced illness and mortality rate
- Create jobs.

(McKinsey & Company, 2013.)

3.2 Importance of cleantech

The environment is very important for every creature, because it's the home where we live. It's a demand to have all time clean air, water and food. If we have sustainable energy, reuse all materials, use green transportation and clean production methods, we will be in a safe haven environment without worries. Climate change is becoming an important issue for the UN to make irreversible decisions to save the ecosystems and the planetary climate system.

The September 2014 UN Climate Summit in New York stressed on emissions reduction, strengthening of climate resilience and mobilize the political will for a meaningful legal agreement in 2015. These actions were altering more growth in cleantech sector.

3.3 Sustainable clean technology

I think to sustain the future of our planet is not about protesting against the industry, just to have clean products using sustainable methods. Cleantech is the answer, but only when industries, consumers, investors, institutions and cleantech providers are engaged to interact with each other. One of the platforms where to share the efforts and commitments made by governments, companies, institutions, civil societies and all involved factors to exchange information as partners and not as competitors is the UN Climate Summit which promote the followings:

- Introducing partnerships between different factors in cleantech sector
- Offering different opportunities and development projects in different cleantech
- Internationalization of cleantech industry
- Facilitate the funds available for projects in cleantech.

(UN Climate Summit, 2014.)

3.4 Cleantech solutions

Cleantech is offering different solutions to minimize pollutions and advocate better use of resources in different approaches such as:

- Product recycling
- Energy renewing
- Advocating ecological building
- Enhancing nature-friendly logistics systems.
- Introducing energy-efficient systems

All the above will minimize pollution, save nature and have a healthier environment. Some examples of cleantech solutions are highlighted below.

3.4.1 Energy generation

Cleantech will provide alternative renewable energy sources such as:

- Solar Energy
- CIGS (Copper Indium Gallium Selenide)

- Ethanol
- Wave energy capture
- Agricultural waste to energy systems
- Advanced fluid flow designs
- Wind power
- Biofuels
- Biogas
- Waste heat

(The Cleantech Open, 2014.)

3.4.2 Energy distribution and storage

Using different cleantech technologies consumers can manage their energy distribution and storaging in real time. There are intelligent sensors used to produce in different stages such as:

- Automated metering system at home, office or company electrical network
- Network architecture for power management
- Battery cycle life improvement
- Reduce the losses in transmission and distribution
- Real time monitoring system.

3.4.3 Energy efficiency

It's the process to use smart tools as software to reduce the usage of energy by integrating the resources to share the produced energy such as:

- Control building lighting
- Having materials that reflect lights
- Automatic switching

3.4.4 Green Buildings

Green buildings' cleantech solutions focus on improving of construction designs and products to reduce the use of hazardous materials, encourage the use of environmentally friendly materials and advocate the use of recycled items.
Examples of developing green building:

- Use of insulation materials
- Having alternative building materials

- Promoting practical architectural designs and modification technologies.
- Sharing a good water networking to save water
- Promoting the use of recycled materials.

3.4.5 Green transportation

Advocate the means of mobility by reducing the use of vehicles by logistics planning and improving fuel efficiency and the main examples are:

- Promoting biodiesel and electric applications
- Having good logistics management system
- Having sustainable and environmentally friendly designs.

3.4.6 Water management

There are different techniques used to categorize and prioritize water usage weather for drinking washing or other purposes and here are some of the examples:

- Using purification methods to categorize water for drinking, then left water can be used for other purposes.
- Promoting the use of natural pesticides and sustainable fertilizers
- Advocating precision agriculture by having automated irrigation techniques
- Real-time water monitoring techniques
- Reusing of recycled water.

3.5 Commercialization of cleantech

World population is growing very fast, industries are increasing and the habit of living are changing which have dramatic effect to limit the natural resources and pollute the environment. Advocating cleantech technologies such as wind energy, solar power, natural gas technologies, biomass, biofuels, water technologies, waste management, material recycling and energy, environmental management and energy efficiency create good alternatives to reduce the pollution.

According to the American based Global Midwest Alliance global cleantech market is worth some 5 trillion USD, and the forecast is to exceed 9 trillion USD by 2015. The most active areas where the business is happening are renewable energy, sustainable

manufacturing, clean technologies, environmental industries and green buildings (Global Midwest Alliance, 2014).

Improved technology introduced better ways of doing things which let to increase innovations and commercial introduction of new technologies. This causes global economic growth of an increase in aggregated demands and supply. The increased industries benefiting from the new technologies impacted the environment and limited the resources. Cleantech is globally commercialized not only generating profits but also as sustainable solutions to maintain the balance between industries growth and environmental impacts.

4 CLEANTECH INDUSTRY IN FINLAND

Finland is a home to about 5.4 million people, 78 percent of its land is covered with forest and 10 percent with more than 187,000 lakes. The country is very famous in IT and communications through its technical breakthrough of GSM. One of the historic success which shaped the Finnish international market is Nokia, but Finland also has a sizable other industries one of them is cleantech which is expected to be the new Nokia of Finland.

Supporting the country's national action plan, Cleantech Finland Project is created to develop an environmental business concept. The project is owned by the Confederation of Finnish Industries and backed by the Government of Finland. It brings together expertise from Finland's clean technology industry, research and also support clean technology companies internationally.
This project is managed by Finpro which an association is providing services for the Finnish enterprises to grow internationally and promoting foreign investment in Finland.

As the nature reserve is a very big concern for every Finn, the country has vigorous policies and regulations balance to sustain the environment, those help the country to be expert within the cleantech industry and grow in many other industries. Cleantech sector is well benefiting from the country's high tech profile, strict but favourable environmental policies, population's love and care about nature, and the appeal of having a prevented health care society.

Through the advanced education and research of a generous support by the government, cleantech Finland sector is becoming very famous not only locally, but also globally, promoting the practice of having technological products or services that sustain the environment, improve the operational performance, productivity, efficiency and reducing costs. (Sitra, the Finnish Innovation Fund, 2007).

4.1 Main drivers for Finland Cleantech

The main drivers of cleantech Finland are:

- Ambitions to have efficient and secure energy
- Leading innovations within cleantech
- Generous funding to R&D
- Using technology as tools to overcome challenges especially within the energy sources issues
- Reducing greenhouse gas emissions per capita

- Reducing consumption per capita as one of the highest in the world
- Cold climate which need high consumption of energy
- Finland's long distances, no or few natural oil and gas reserves
- Energy intensive industry like paper and pulp industry.

4.2 Main areas of Finland cleantech

Finland is a global leader in different cleantech solutions as energy efficiency, industrial processes, renewable and bioenergy, water management and waste treatment. (Invest in Finland, 2013).
The following are some examples where cleantech Finland is active.

4.2.1 Water

The country has huge resources of water but the sector is very active in the following areas in water technology

- Efficient use of water
- Purification
- Waste water treatment

4.2.2 Energy

The main areas in energy efficiency are the following:

- CHP (combined heat and power)
- Energy efficiency
- Biomass and bioenergy
- Renewable energy (solar, wind)
- Smart grid

4.2.3 Waste management

The main areas in waste management are the following:

- Industrial waste management
- Residential waste management
- Logistics
- Recycling
- Waste to energy

4.2.4 Built environment

The main areas of environmentally friendly buildings are the following:

- Air quality
- Energy management system
- Low energy housing
- Smart mobility
- Urban planning

4.3 Cleantech Finland strategies

Cleantech Finland strategy is to provide a global network of top cleantech expertise to achieve the following:

- Finland to be known as a global superpower of cleantech by 2020
- To raise cleantech companies' turnover
- To increase cleantech exports
- To increase the cleantech home market
- To raise the number of cleantech companies
- To create cleantech jobs in Finland and globally.

4.4 Achieving the strategies of Cleantech Finland

To achieve the strategies Finland Government has prioritized cleantech strategy planning actions which are defined as following (Government Strategy to Promote Cleantech Business in Finland, 2014):

- Making cleantech the spearhead theme of the country brand.
- Promoting cleantech investments.
- Creating cleantech demonstration environments.
- Establishing the Cleantech Finland Board, which transcends the boundaries of administration?

The Government also has a list of development actions which are defined as (Government Strategy to Promote Cleantech Business in Finland, 2014):

- Taking the promotion of the cleantech business into account in international influencing activities.
- Clarifying and speeding up the slow and complicated licensing processes.
- Developing regulation to support cleantech innovations and their implementation.

- Securing the foundation of skills and knowledge through research and education.

5 QATAR INVESTMENT OPPORTUNITIES

Qatar may look small for its size, but for investment it's a global rising giant, the world's largest exporter of LNG (liquefied natural gas) the status in which gas is converted to liquid to ease the storage and transportation over long distances. LNG, crude oil, and petroleum exports account for 60% of Qatar total revenue, but the country has well realized the importance of economic diversification to reduce the depletion of its oil reserve, to invest in different areas that would each react differently to the international market and gain experiences in different area aiming to become a leader country in terms of business environment and foreign investment. To meet these targets the country has encouraged investments opportunities in different sectors. The process has increased the population to more than 1.9 million in 2013, of which Qatari national are less than 15% of the total population (Kinninmont, 2013.)

5.1 Qatar's encouraging investment environments

By adopting an open market policy which helps investors to achieve better profits, the country has many encouraging investment environments factors. The following are just some examples:

- Wealthy country from the gas production income, which has been reinvested and economically diversified.
- Fast economic development
- Political stability within the region as many companies see the country as starting point for exploring the rest of Gulf countries
- Safety and security within the country
- Readiness to invest which stimulate the foreign investment
- Relaxation in immigration policies because of which immigrants are outnumbering native Qataris by about eight to one, making it almost the biggest ratio of migrants to citizens in the world which attract the best experts from the region at the moment.
- High economic expansion of a 12.9 average a year from 2000 to 2010, which makes it one of the highest among the wealthy countries.
- Flexible rules in business and investment

- Generosity and freedom of unrestricted and movable fund.
- Recognized political weight specially in dispute solving
- Geographical location the sea.
- Planning of mega projects
- The low corporate tax comparing to other countries especially in Europe and America.

(Qatari Ministry of Foreign Affairs, 2013)

The country's transparent investment policy is very encouraging not only for locals but also for foreign investors. The above mentioned points are some of the encouraging investment environments factors have helped the country to be recognized as the fastest growing economy in the region, an important global financial investor, labour importer and donor.

Qatar adoption of an open market policy has raised the profit and led the country to emerge as the richest country in the world. Table 1 shows the GDP (gross domestic product) based on PPP (purchasing power parity) per capita for year 2014.

TABLE 1. Ten richest countries in the World. (World Economic Outlook Database, October 2014.)

Richest Countries in the World in year 2014		
RANK	COUNTRY	Current International Dollar (GDP based on PPP per capita YEAR 2014)
1	Qatar	1,45,894.18
2	Luxembourg	90 332.89
3	Singapore	78 761.92
4	Brunei Darussalam	73 823.13
5	Kuwait	70 785.46
6	Norway	64 363.14
7	United Arab Emirates	63 180.83
8	Switzerland	53 976.60
9	United States	53 000.97
10	Hong Kong	52 984.06

5.2 Qatar's investments strength

Qatar has earned strong gains in revenues from oil and gas which account for 50% of its GDP. It has made the country the world's highest per-capita income and the lowest unemployment. Still the country has proved oil reserves in excess of 25 billion barrels enabled to continue outputting at the current level for 57 years, while the proved reserves of natural gas are exceeding 25 trillion cubic meters or 13% of the world total reserve. But the country's economic policy is focused in the diversification by utilizing these revenues to other private and foreign investments. (index mundi, 2014).

5.2.1 Investment incentives

Realizing that investors want to have transparent environment in business, Qatar has set fair regulations and rules in practice to establish a legal framework for companies and firms to operate in the country and benefit from the investment incentives.(Qatar Ministry of Foreign Affairs, 2015).

To attract both local and foreign investors the following are some of the incentives:

- Low electricity, water and gas bill rates.
- Nominal lease rate of only (5) Qatari Riyals per square meter per year for industrial land for the first three years from site assignment and project operation, with an increase of (10) Qatari Riyals after this period.
- No import taxes on heavy duty machinery and their spare parts.
- No import taxes for raw materials.
- No import taxes.
- Unlimited quantities of imported materials.
- No restrictions on money exchange and transfer of profits abroad.
- Flexible regulations and procedures to import skilled and unskilled workforce.
- Tax free salaries.
- Excellent medical and educational facilities.
- Advanced telecommunication facilities.

5.3 Foreign investment in Qatar

Qatar welcomes foreign participation in all various sectors of national economy with 51% Qatari national ownership.

Foreign investors can have 100% ownership of the share capital under Foreign Investment Law if they invest in projects of the following fields

- Agriculture
- Industry
- Health
- Education
- Tourism
- Development and exploitation of natural resources, energy and mining
- Consulting services
- Information technology
- Cultural services
- Sport services
- Art work services
- Entertainment services

There are also some tax exemptions if investments are for projects that contribute to the development of Qatar after ministerial approval.(Qatar Ministry of economy and commerce, 2015.)

The QSTP (Qatar Science and Technology Park) allows 100% foreign ownership, facilitate onshore trading licensing, ability to repatriate profits and capital for energy, environment, health sciences, and ICT involved investments. It's possible to access different support services like accommodation within the host offices, laboratories and training facilities if the investment is in research and development projects. QFC (Qatar Financial Centre) is facilitating 100% foreign ownership business practices which is not restricting to a physical existence in a certain place as long as the investor is ready to stay in Qatar.

5.3.1 Establishing legal representation in Qatar

To establish a legal foreign investment representation in Qatar there are commercial arrangements that need to be conducted and the following are some of them (Villiers Terblanche, Ahmad Anani, Andrew Macklin, 2013):

- Incorporating a local entity according to the commercial companies' law
- Obtaining a licence for a temporary branch an office representative
- Registering with the QFC (Qatar Financial Centre)
- Registering with the Qatar Science and Technology Park (the QSTP)
- Appointing a business agent
- Appointing a distributor
- Having commercial representative.

5.4 Qatar Cleantech

In recent years Qatar has become one of the influential and rising powers both politically and economically within the Middle East and growing globally advocating an image of peace and neutrality which help the country to gain stability and witness a massive increase in industries related to oil and gas production resulted in revenues used for huge construction projects which have caused population growth.

5.4.1 Balancing the economical rise and environmental impacts

To reduce the negative environmental impacts and protect the natural resources, the country has introduced different measures and the following are some of them (Advancing Sustainable Development, QATAR NATIONAL VISION 2030, 2009):

- Pursuing clean energy strategies.
- Increasing energy efficiency.
- Introducing alternative electricity sources to preserve precious fossil fuels for international markets and safe reserves to future generations.
- Reducing waste.
- Reducing energy consumption and dependence on fossil fuels.
- Addressing climate change issues and well involved within the UN resolutions.
- Low consternation of GHG (greenhouse gas) emissions in the atmosphere.
- Increasing environmental awareness.

5.4.2 Introducing cleantech solutions

To put the negative environmental impacts and natural resources protection measures into real practices the country has actively involved in cleantech as solutions and here are some examples (Advancing Sustainable Development, QATAR NATIONAL VISION 2030, 2009):

- Introducing the environmentally friendly technologies
- Investing heavily in technology research centres
- Introducing cleantech funds
- Boosting research activities
- Sustaining development projects aiming to preserve natural resources
- Increase investments in cleantech sector
- Bringing World class institutions to country.

- Initiating strong bodies for education and research like Qatar Foundation
- Educating its community, especially the youth, about cleantech practices

6 CLEANTECH FINLAND OPPORTUNITIES IN QATAR

The global cleantech market is worth approximately 200 billion USD a year (Kiernan, 2009). The Finnish cleantech sector continued to grow in 2013 of an average of 5% and a combined turnover of euros 18.8 billion USD, planning 88 % international markets expansion for the next 5 years (Kitunen, 2014.)

The key markets for cleantech Finland were Sweden, Germany, Russia, UK and China. To have its share from huge global market and increase its chances to reach the expansion targets, the sector is actively looking for good opportunities and has well placed itself within the competitive market. The sector has made many successful solutions and should expand its operation and Qatar is a very good opportunity.

Mike Pitts (2015) states that "Investors want to feel the person leading the business is committed to that business, so if you have a bit of a story about why you are doing what you are doing, communicate it".(Vella 2015).

6.1 Cleantech opportunities in Qatar

Qatar may look small but it's a global rising giant in investments, and is seeking only quality business which helps to transform the country as an advanced economy in the region. To balance its fast economic growth with environmental impacts the country is in a permanent search for best cleantech solutions available.

6.1.1 Cleantech Finland ranking

- No 1 EU eco-innovation scoreboard 2012
- No 2 in environmental friendliness country brand index 2011-2012
- No 4 global cleantech index
- Finnish company Eniram has been named one of the five European Cleantech companies of the decade by CTG (Cleantech Group).
- Four Finnish cleantech companies has been selected amongst top companies in Nordic Cleantech Open competition
- Zen Robotics, the Finnish robotic recycling systems specialist was named as one of GCCA (Global Cleantech Cluster Association's) award winners for 2013.

- The Global Cleantech Cluster Association (GCCA) named two Finnish companies among its ten winners for the 2011 Later Stage Award.

Cleantech Finland has good chance to compete, but entering the global market product and service demand should be carefully studied and the option needs to be clearly identified.
The two major drivers for the global investment in Qatar are Qatar 2022 FIFA World Cup and Qatar National Vision 2030.

6.2 Qatar 2022 FIFA World Cup

The average spending for the last two World Cups were about 2.7 billion USD for 2010 World Cup in South Africa and 14 billion USD for 2014 World Cup in Brazil. While Qatar has reserved 200 billion to be spend for the 2022 FIFA World Cup event to guarantee its success. (Sean Gregory, 2013.) To facilitate the event the country has planned huge construction projects in different sectors. Most of them have started and some even finalized.

6.3 Qatar National Vision 2030

The Vision is meant to serve as a clear development roadmap for the country's future within the coming decades to continue its achievement in economic growth while balancing the accomplishment in the following pillars (Qatar Ministry of Development Planning and Statistics, 2015):

- Economic development
- Social development
- Human development
- Environmental development

To meet the national vision goal and produce a successful World Cup the country had made it very clear that it requires investment and cooperation from foreign countries in different areas of expertise.

6.4 Mega infrastructure projects

The mega investment projects are preparation for the FIFA 2022 World cup event, also a full scaling of construction and development to fulfil the country's 2030 National Vision.

Here is a list of the best known mega infrastructure projects for the event and beyond:

- $77 billion on facilities for football fans
- **$**50 billion for developing new advanced rail transit and metro systems
- $48 billion will be spent to build air conditioned stadia
- $33 billion for developing the coastal City of Lusail located about 23 km north of the city centre of Doha
- $20 billion on high profile roads project
- $17.5 billion for one of the largest world class airports
- $5.5 billion for a deep-water seaport
- $4 billion on stadiums.

One of most encouraging investment sectors is the fastest growing construction market which is expected to grow by an average of 12.5% a year over the next decade according to a study by Oxford Economics and Global Construction Perspectives.
The second encouraging factor is that the government has reported that 40% of its budget between 2012 and 2016 is allocated for projects in infrastructure (Commercial Bank of Qatar, 2012.)

6.5 Qatar Cleantech opportunities during the 2022 World Cup and beyond

The large pipelines of World Cup constructions need huge investment in major cleantech areas like energy efficiency, renewable energy, water management, waste management, environmentally friendly buildings, cooling technology, clean supply chain and sustainable health care system.

Qatar also has tremendous efforts to emerge as a cleantech R&D and manufacturing hub for the Middle East (Hayes, 2013.) In order to achieve this goal the country has allocated a cleantech partnership investment fund, established well equipped research centres and scheduled many seminars and conferences in the field. Qatar Sustainability Conference is a good example of this. In the following sections there are some examples for the main focus areas in cleantech for the mega projects activities.

6.5.1 Energy

The rapid expanding economy and growing population increase the demand for power both for industry and households. The mega projects for the FIFA 2022 World Cup and the Qatar national vision need more electricity. The country also has set clear measures to adopt clean, efficient and sustainable energy cleantech solutions in different areas and the following are just some examples where the investment is possible.

- Energy storing
- Energy efficiency
- Biomass & bioenergy
- Renewable energy
- Smart grid.

6.5.2 Water management

Water generation facilities, distribution networks, water saving, and good water measures will be among the top priorities for the country where it's possible to invest to achieve its targets in 2030 National Vision and the following are some of the activities where investment is needed.

- Efficient use of water
- Waste water treatment and purification
- Installation of sustainable centralized water networks
- Reuse of water for plantation, green park creation

The recycled water can be used to create green spaces which are needed very much in the country.

6.5.3 Environmental friendly buildings

The large urban development to meet both the FIFA 2022 World Cup and the Qatar national vision 2030 has let the country's building sector to grow exponentially but the government is highly committed to improve the building environment by promoting green building practices. Qatar National Convention Centre which was developed by Qatar Foundation is just one example of achievements to be awarded a gold standard under the US green Building Council's Leadership in Energy and Environment Design. (OXFORD BUSINESS GROUP, 2015.)

QGBC (Qatar Green Building Council) is a non-profit, membership-driven organization and a member of Qatar Foundation. It's a prominent body in Qatar aiming to support sustainability environment while having a secure economy by providing leadership and encouraging collaboration to conduct environmentally sustainable solutions in Qatar (Qatar Green Building Council, 2014.)

The following are some of the areas where it's possible to invest in environmental friendly building projects:

- Air quality

- Energy management systems
- Low-energy housing
- Smart mobility
- Green building materials
- Recycling
- Urban planning.

6.5.4 Waste management

The huge industrial activities, mega construction projects and growth of population produce a large quantity of waste. The country produces more than 7,000 tons of solid waste every day. The households are responsible for 30% of it, while the rest is from commerce, industry, and construction activities. Most of this waste is going to landfills. But the government has developed good strategies and assigned good budget to manage the waste production to reduce the waste going to landfills by increasing the recycling practices and convert it to energy (Government of Qatar, 2015.)

The FIFA 2022 World Cup will generate a huge loads of rubbish which need a sustainable waste management programme. Qatar had provided good solutions for sustainable social and human development, which were of high demands during the FIFA bid. To implement these solutions the country is in search of best waste management practices available and here are the areas where to invest:

- Industrial waste management
- Housing waste management
- Events waste management
- Recycling
- Waste to energy.

6.5.5 Green logistics

Qatar is planning to set its capital Doha on smart cities sights by equipping it with best infrastructure and sustainable environmental solutions to give a decent quality of life. Therefore the country has planned $70 billion worth full short term integrated multimode transportation projects of different drivers to support its National Vision 2030, meet the needs for 2022 FIFA World Cup, and regulate safety, health, environment and to position its capital city Doha as the global trade and transportation hub especially for the Middle East, Africa, Asia and Europe (ITS International, 2013.)

To commit to its national environmental strategies by dedicating to sustainable environmentally friendly solutions, the country is always searching for good cleantech solutions within the transportation system and it's the first country in the region to start solar cars and battery powered buses to enhance environmentally-friendly public transport system. (Barbara Bibbo, 2008.) There are a lot investment opportunities in rail, aviation, roads, ports and green logistics.

6.5.6 Air conditioning

The toughest issue for Qatar to host FIFA 2022 World Cup is the heat problem as and average temperature can reach 50 degrees Celsius. The country has promised an advanced air conditioning technology which is able to cool stadiums, training pitches, fan zones ad even walking paths between metro stations and stadiums to about 24-28 degree Celsius. This helped the country to win the competition and qualified it to arrange the event. The country has assigned a huge budget and facilitated research centres in all fields.

One of the interesting air conditioning proposals was the fleet of solar powered clouds research project suggested by Dr. Saud Abdul Ghani and his team Dr. Ghani, the head of Mechanical and Industrial Engineering at Qatar University. He described the operation as slow drone's aircraft, made of 100 percent light carbonic materials and controlled remotely. (Joseph L. Flatley, 2011.)

In April 2015 Al Rayyan stadium design which was produced by the UK based architecture firms Ramboll and Pattern has been launched as the first of Qatar 2022 FIFA fifth stadiums to use the cooling technology. Construction will start in 2016 and to be completed by early 2019. (Mail Online, 2015.)

But still there are many areas where cleantech solutions need to be applied for air cooling, and Qatar is ready to invest.

6.5.7 Cleantech R&D

Qatar Foundation for education, Sciences and Community Development is a non-profit organization aiming to contribute to human development nationally, regionally and internationally. By well-established research organizations like QNRF (Qatar National Research Fund), QSTP (Qatar Science and Technology Park), QBRI (The Qatar

Biomedical Research Institute), QCRI (Qatar Computing Research Institute) and QEERI (Qatar Environment and Energy Research Institute) (Qatar Foundation, 2015.)

The foundation is very generous to assist in research projects both nationally and internationally through its different research institutions. There are also other research and fund opportunities in Qatar for good cleantech solutions.

6.5.8 Innovation in cleantech

Qatar is creating good environment to encourage innovations by holding global seminars and conferences in the country to exchange ideas and bridge the gap of communication between institutions, government bodies, and agencies, industries to initiate collaboration in cleantech solutions and reward innovators for encouragement.

7 EXPORTING CLEANTECH FINLAND TO QATAR

7.1 Competitiveness

Finland cleantech industry is growing fast as a world class industry reserving a top place within the global top ranking of a high technology perspective, strong commitment to present a clean nature as part of the country's ethics, advocate positive use of resources, readiness to collaborate and share experiences. The sector has grown very fast benefiting from Finland's good reputation as the globally best in education, and having high technology, very generous government support in R&D spending, the best quality of human resources, stability, and leading innovations with high cooperation between companies and institutions.

7.1.1 Finland World ranking

Finland is a top ranking country in many areas. The followings are some examples:

- Highest quality of export products in EU, 2014.
- Second in EU Social Justice Index, 2014
- Fourth most reputable country, 2014
- Fourth in global innovativeness, 2014
- Cleanest air in Europe, 2014
- Sixth in the Global Peace Index, 2014
- Ninth best country in world to do business for 2014-2018
- Second in the Global Cleantech Innovation, 2014
- Second in the European Eco-Innovator index, 2014
- First in World Press Freedom index, 2014
- Third in Transparency in the world, 2013
- Second best in the world human capital, 2013
- Fifth country in the world as a place for dynamic businesses to flourish, 2013
- Best public transport in Europe is Helsinki, 2013
- Third in the World Economic Forum Global Competitiveness Report
- The least failed state in the world, 2014
- Best education system in the world, 2013
- Cleanest in Europe, 2013
- Best country in the world for mining, 2013
- First in World Economic Forum's Networked Readiness Index, 2014

- Second in World Competitiveness Rankings in institutional pillars
- One of the world's safest airlines, 2013.

(FINLAND IN WORLD RANKINGS, 2014.)

7.1.2 Finland Cleantech global image

The global environmental impacts have forced many governments and corporations to recognise the need for developing and implementing sustainable strategies to mitigate the risks of pollutions and negative exploitation of natural resources and seize many investments opportunities both for national and international cleantech industries. Finland as a top high tech country is well responding to the global cleantech appeals. There are thousands of cleantech companies in Finland. Many of these companies are global leaders within the industry.

Table 2 below shows 10 famous cleantech Finland companies and their areas of solutions.

TABLE 2.Top 10 Finnish cleantech companies (Cleantech Finland, 2013.)

No	Company	Cleantech areas
1	Wärtsila	Energy efficiency, renewable energy
2	Metso	Built environment, energy efficiency, renewable energy, mining and recycling technology
3	Neste Oil	Renewable energy
4	Outotec	Energy efficiency, renewable energy, mining and water technology
5	Kemira	Energy efficiency, water technology
6	YIT	Built environment, energy efficiency and renewable energy
7	ABB	Energy efficiency, Green ICT and measurement technology
8	Kuusakoski	Recycling
9	Outokumpu	Built environment, energy efficiency
10	Cargotec	Cargo handling solutions

7.2 Developing export strategies

Middle East and especially the Gulf countries are seen as a heaven for exports as the region is very rich and of high product consumption. But the competition is very tough. There are some countries like USA and UK, which, because of the historic relation and political involvement, are dominating the market in the region. Today, customers' demands within the region have changed. They are becoming more product-oriented looking for the best quality product and good price. This has changed the previous traditional trading approaches and helped so many companies to compete in a fair market. Finland cleantech industries have been recognized globally, but need extra marketing efforts to increase their exporting level to fully succeed in a competitive new market like Qatar. To have successful business in Qatar, they need to conduct extensive market knowledge of product demand, customers and competitors. The following sections introduce some of the approaches.

7.2.1 Hosting different cleantech industry forums

Finland should increase its marketing and advertising approaches when offering its strengths as an advanced country in high-tech, good education, good reserve of quality human resources, good product and services to others. This could be done through:

- Holding seminars and conferences both in Qatar and Finland to introduce Finland cleantech product and services.
- Increasing investment accessibility between the two countries between Qatar and Finland.
- Facilitating business to business opportunities between the two countries.
- Leveraging resources that support cleantech industry and share the solutions.
- Driving partnership relations between two countries trading bodies like Chamber of Commerce, trade cooperation councils, investment authorities and agencies.
- Introducing funds to benefit both companies and individuals in cleantech sector.
- Using technology like online services as tools to ease the investment operation
- Introducing bilateral investment agreements.

7.2.2 Building relations

There are big Qatari investments in different countries while the country is hosting many foreign companies to be involved in different sectors. Cleantech is one of the interesting opportunities, but to compete in this market Finland cleantech should explore ways to build relations between the two countries through the following:

- Creating cooperation in high education by having exchange students, which will create a wider database of graduate students between both countries
- Introducing research opportunities in both countries' universities and centres for research to share their knowledge
- Increasing public relations and activate the role of societies as the Finnish-Qatari association
- Easing tourist opportunities between the two countries
- Easing investment opportunities between two countries
- Encouraging partnership between regions and cities in both countries.

7.2.3 Communication

Before starting business communication there are different factors need to be considered such as cultural, political, socio-economical, historical and religious characteristics of a country. In Qatar, a good honest trusted relationship is very important factor in doing a successful business which is likely the same in Finland and eases the communication for cleantech companies. Here are some approaches:

- Creation of official visits to strengthen the trade relation
- Holding of social events like sports activities
- Involving the media to deliver messages and ease the communication through information gathering and distribution
- Mobilize immigrants, especially of Middle Eastern background active role for cultural aspects and Arabic language knowledge.

7.3 Examples of the best Finland cleantech solutions

Finland cleantech cluster combines high technology, innovation, the best research institutions and leading four expertise centres in Oulu, Kuopio, Lahti and Helsinki. The sector is well established locally and operating globally in different countries, China and Russia being among the biggest markets. The cluster is benefiting from its best cleantech experts, different supporting bodies, business promoters and official visits.

The Helsinki summit 8-9 September, 2015 global cleantech event was the best opportunity for Finland cleantech cluster to promote itself in markets. The summit provided discussion and development platforms to cleantech strategies to enhance cooperation, introduced new solutions and shared the global business opportunities.

Qatar is a rising star for global business. Finland cleantech companies interested in international opportunities should consider current trends and future projects in Qatar. The following sections show some examples of different Finland cleantech companies and adopted solutions:

7.3.1 Solar energy

Qatar is enabling solar energy power as sustainable solutions to protect environment and develop new industries. The efficient anti-reflection coating products from Optitune based on nanotechnology are the best environmental friendly light management solutions. They minimize the light reflection to decrease light waste in solar energy. It's among the best product commercially available to be promoted. (Optitune, 2015.)

7.3.2 Waste management

Ecosir Group Oy, headquartered in Espoo Finland, is a leading cleantech company specializing in automated and advanced cleantech solutions for mixed and organic waste (BIO waste), energy waste, paper/cardboard material and linen/laundry for hospitals, nursing homes, shopping centres, food service centres, kitchens and city centres of up to 45 ton/day or more capacity and their products provide economical and hygienic solutions. (Ecosir, 2015.)

7.3.3 Bioenergy

The Finnish cleantech company of MetGen Oy was an Award winner of the best in Bio Bio-Fuel/Bio-Energy category for the Global Cleantech Cluster Association (GCCA), 2014.Their eco-friendly enzymatic solution which saves energy with bioenergy power by improving yields production and bioethanol from cellulosic waste and purification of water from phenolic compounds and lignin. Qatar Airways was the world's first commercial flight powered by a GTL (gas-to-liquid) fuel blend and carrying out research to develop sustainable bio jet fuel as part of the country's initiative to heavily involve in cleantech for alternative energy. MetGen enzymatic solutions are the best technologies to offer.

7.3.4 Chemical imaging

Remote sensing of ground information for object classification and recognition using hyperspectral imagery provide geological, environmental, and intelligence data is the

best solution from SPECIM Company based in Oulu, Finland. Its product has been unbeatable worldwide in airborne spectral imaging, chemical imaging, geological imaging and hyperspectral imaging in research. (SPECIM, 2015.) Qatar research centres are active in this technology and ready to cooperate.

7.3.5 Fuel saving and low emission electric drive trains

VISEDO Oy, a company based in Lappeenranta. Finland, is specializing in fuel saving and low emission electric drive trains for heavy mobile work machines, marine vessel and public buses. It was one of three Finnish companies chosen to latest stages of the Global Cleantech Cluster Association (GCCA) Award in 2014 and a winner of the electric system supplier for the world's largest fully electric ferry boat which is to be build buy the Danish shipbuilder Søby Shipyard Ltd. (VISEDO, 2014.)
As Qatar is seeking the best technological solutions available, the company has the best products to offer.

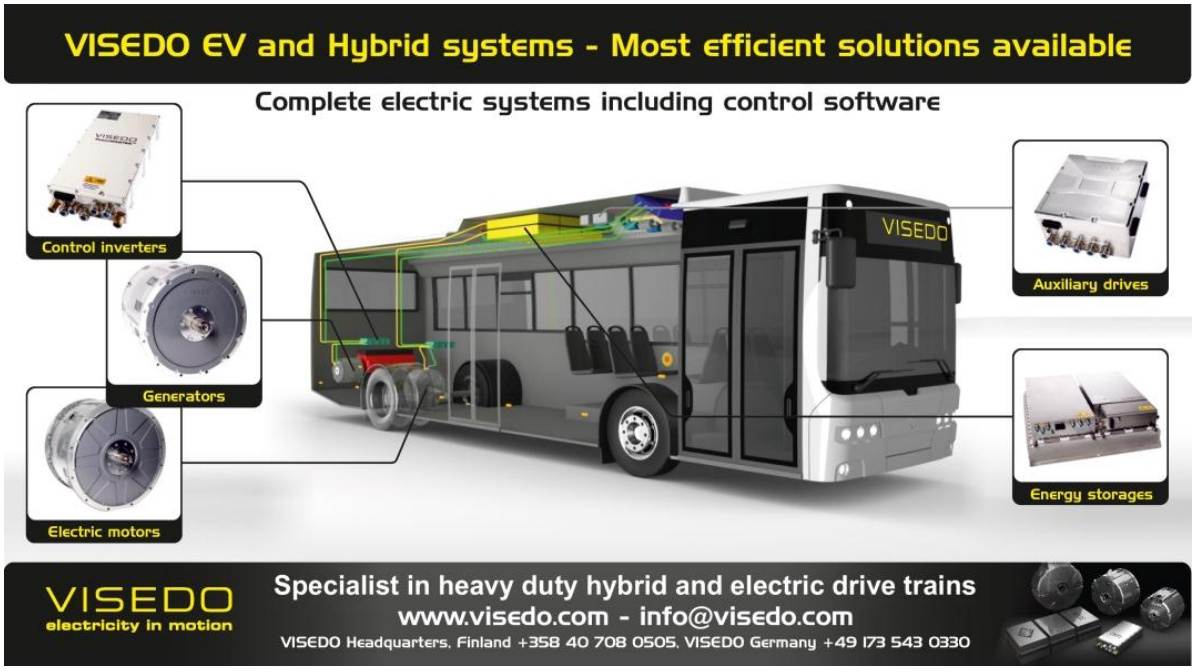

FIGURE 1. VISEDO electric vehicle and hybrid system solution. (VISEDO, 2014.)

7.3.6 District heating

"District heating is produced locally and transferred from the power plant to customers via hot water running through district heating networks. The cooled district heating water is returned to the power plant for reheating". (Fortum, 2014.)

7.3.7 District cooling

The Fortum district cooling solution using cold lake and sea water is an efficient indoor climate without using refrigeration equipment to avoid noises around residential areas. Properties are easily connected to the district cooling system network enjoying less cost and automated centralized monitoring. The company operates the world largest district cooling network in Stockholm, Sweden. It consists of over 200 kilometres and has a capacity of 350 MW. (Fortum, 2015.)

7.3.8 CPH (combined power and heat energy)

Combined power and heat energy has a big role in Finland energy production. It is assumed that 80 percent of the country's district heating is based on energy co generation which the technology to produce heat and power (electricity) simultaneously. (Statistic Finland, 2013).
Some of the main energy production sources are shown in Figure 2.

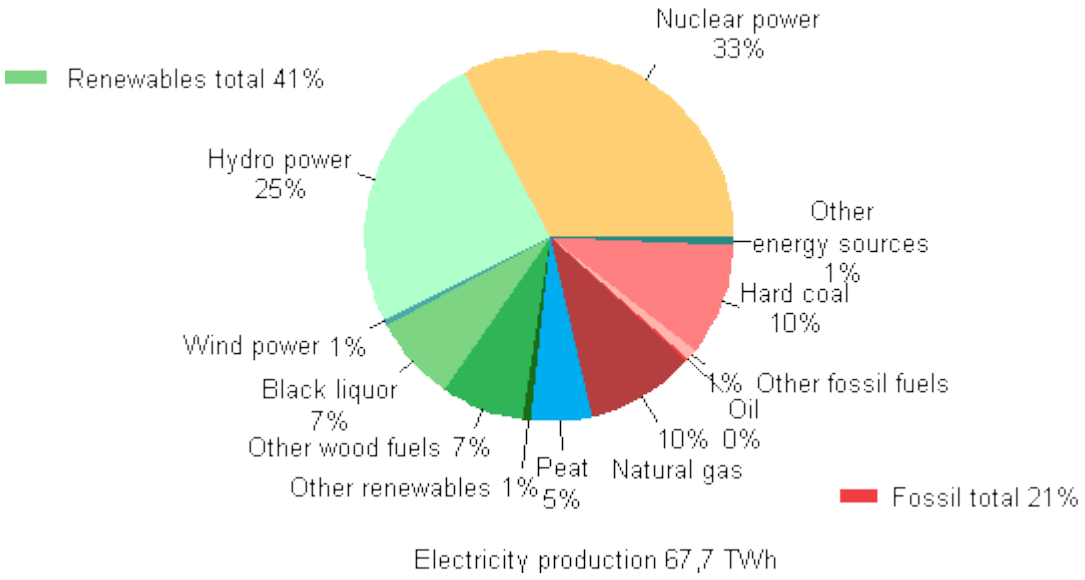

FIGURE 2. Electricity and heat production by energy sources 2012(Statistic Finland, 2013).

7.3.9 Energy efficiency

The Cleantech Company of DigiEcoCity (Digital Ecological City) is specializing in developing of cities that are able to use solar, earth and bioenergy sources as cleantech solution. The waste will be automatically retrieved, recycled and used as low energy

where lighting, water and sewage systems are all implemented according to ecological principles. The company has projects in China to construct digital and ecological cities which a combination of the innovations of **digital** technology with the sustainable development to meet the Chinese government objective to shift approximately 400 million countryside inhabitants into cities in the next 15-20 years. (Juha Lipiainen, 2012.)

7.3.10 Waste monitoring solution

Enevo One is a complete waste monitoring solution from enevo which a Cleantech Company based in Espoo, Finland. Wireless sensor technology is used to detect different items like glass, bio, metals and fluids such as oils and waste water in waste mixed container. The waste is detected in real time to help the scheduling process for providing containers and fleet system management to bring saving up to 50% in waste collection. It is reducing costs, emissions, road and vehicle wear, noise pollution and working hours creating smart city environment. (enevo, 2015.)

7.3.11 Air purification

Genano cleantech company air purification technology is removing air particles from indoor contaminated areas such as hospitals, stadiums and industries. These particles can be ultra-small particles of three nanometer sized (1 nm = one millionth of a millimetre), harmful gases, and toxins released from building materials. It also eliminates and kills organic particles such as bacteria and viruses. The system can be installed in crowed areas like hospitals, industries or even stadiums. (Genano Ltd 2015.)

7.3.12 Metal recycling

Scraped metal recycling and processing is a big cleantech solution by Metso Company which operates globally. Their main product includes automobile shredders and shredder plants, pre-shredders, scrap shears, scrap baling presses, briquetting presses, turnings and metal crushers, and anode crushers. The company is also specialized in installation, commissioning, inspection, maintenance and repairs and offer solutions for product optimization. (Metso, 2015.)

7.3.13 Gas cleaning

Outotech is specializing in gas cleaning technology of a high and effective particle removal capability which can be optimized for different processes, raw materials, and

energy sources. As shown in Figure 3, dust, which can have impact on process efficiency, is carried away from raw materials with the off gases using wet type separator which collects solids from off gases and is depositing them on a collection surface. Then there are removed for recovery or disposal.(Outotec, 2015.)

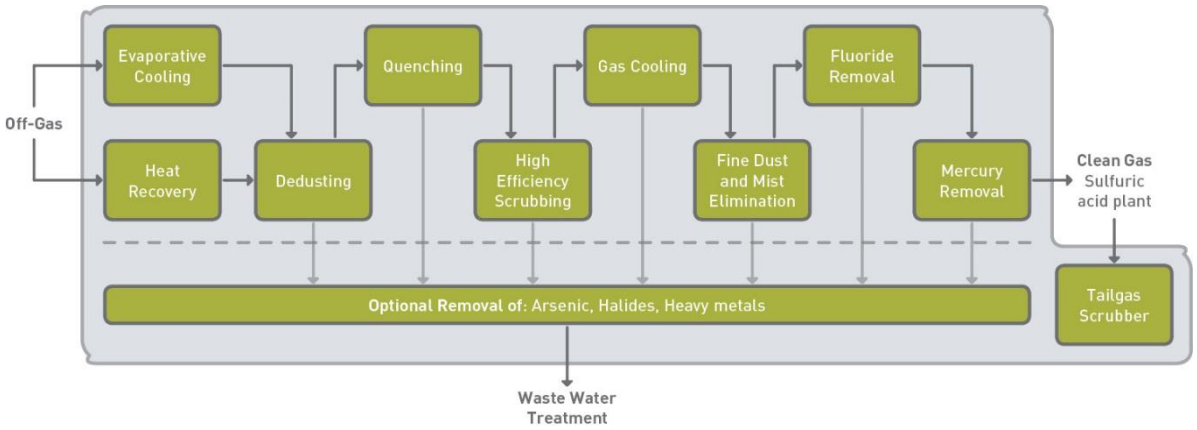

FIGURE 3. Gas cleaning processing (Outotec, 2015).

7.3.14 Recycling of hazardous batteries and accumulators

AkkuSer a cleantech solution company, which is located in Nivala, Finland, is the first in the EU to develop an environmentally sustainable technology that enables recycling of hazardous batteries and accumulators. It's a dry process which separates valuable metals from rechargeable batteries. Elements are identified, crushed, sorted and packed as raw materials ready to be shipped to suppliers. The process makes it possible to reuse more than 90 percent of batteries. (AkkuSer, 2013.)

7.3.15 Waste to energy

BMH Technology Oy, a company located in Rauma, Finland, has a cleantech solution to transform waste into high quality SRF (solid recovered fuel). Through an automated process called TYRANNOSAURUS® SRF everything from household and commercial waste to industrial waste and difficult mono fractions is to be turned into high quality SRF. It has the ability to reduce any metal of any size to 80 mm one single phase of equal particles which are flowing out of the shredder to the next equipment during the operation of reducing metal sizes to smaller for easing its handling for recycling process.

During the process, ferrous metals are separated by belt magnets, while sand, soil, organics, and other small heavy wet particles by the TYRANNOSAURUS® FINES SCREEN. Conductive metals, such as aluminium and copper, are separated by eddy current separators while heavy fraction, which consists of inert material such as stones, glass, concrete, rest metals and heavy organic fractions are separated by what is called TYRANNOSAURUS® AIR CLASSIFIER. (BMH Technology Oy, 2010.)

7.3.16 Energy consumption monitoring

The web application software of Eneron Oy Company, which located in Espoo, Finland, is one of the world's most advanced web application for energy-efficient real estate management. It is a flexible automated customer feature requirement product and compatible with the EU's Energy Efficiency Directive compatible. The product offers opportunities for integrating building engineering equipment to monitor their conditions and consumption in a real time. The data collection system supports different alarm and control networks while it's able to monitor the renewable energy yields in real time. (Eneron, 2014.)

7.3.17 Renewable diesel

Neste Company, headquartered in Espoo, Finland, is a refining and marketing company, that produces range of major petroleum products and is concentrating on low-emission, high-quality traffic fuels as the world's leading supplier of renewable diesel. The Diesel HPR (High Performance Renewable) is a low-carbon renewable fuel to be used in diesel engines offering better performance and lower emission. Its renewable diesel is sold in the USA Propel fuel stations as most advanced low carbon diesel fuel (Markus Kitunen, 2015.)

"According to the U.S. Department of Energy's Alternative Fuels Data Center, renewable diesel's high combustion quality results in similar or better vehicle performance compared to conventional diesel, while CARB studies show that renewable diesel can reach up to 70% greenhouse gas reduction compared to petroleum diesel". (Markus Kitunen, 2015.)

7.3.18 Waste water and process water treatment

Watrec Ltd located in Forssa, Finland, is a cleantech company. Their waste water treatment approach is a composting facility post process outside a field, using rain water to flush some of the organics and nutrients from the field post compost mass. The flush

water is collected and pumped into waste water treatment process where phosphorous, suspended solids, and organic material are removed from water through chemical-physical process then the treated water is received within the assigned used water network. It is reliable and compatible with the Finnish Environmental Authorities requirements. (Watrec, 2012.)

7.3.19 Solid waste treatment

Car tyres are disposed in different methods. Many of these are not eco-friendly especially. Millions of tyres end up to tyres' graveyards. Tyres' recycling is one of the fastest growing business opportunities around the world as many countries have banned tyres from landfill.

TANA Oy is a global leader company based in Jyväskylä, Finland, and specializing in landfill compactors. There are different solutions to the problem producing like different machineries such as mobile waste shredders on semi-trailer, mobile waste shredders on tracks and stationary electric waste shredders of a capacity of 30 tonnes per hour. According to TANA, "Rubber waste originated from car and truck tyres is almost equal in heat value as gasoil and even 25% more effective than coal" (TANA, 2012.) These machines will eliminate the graveyard landfill, reduce cost of tyre transport, and separate metals from plastic. The result of this cleantech solutions adopted by TANA is shown in Table 3.

TABLE 3. TANA tyre recycling process result (TANA, 2015).

Process with TANA Shark 440	Additional information
1. The waste with long metal wires and plastics are cut and shred into small pieces.	TANA Shark has the ability to cut through the waste – not to tear it. This reduces downtime caused by the metal wires and plastics wrapping around the rotor, which does not happen with TANA Shark.
2. Metal wires heats up when shred.	The heat helps to dry up the wet pulp and to remove the pulp residues from the metals.
3. Metal, plastic and pulp are separated.	Achieved from the conveyor with a magnet and an air blowing or suction process.
End results: -> Very clean recycled scrap metal, particle size below 110 mm, ready for selling -> Clean plastic and pulp residues are ready to be used for burning purposes	

7.3.20 Wall solar power

Ruukki Company is based in Helsinki, Finland, and is part of the Swedish SSAB. It specialises in steel and steel construction and the company has expanded its solar power product range having the new solar panel solution which can be installed on a new or renovated building's facade to convert sunlight into electricity. Installation can suit retail, industrial, warehouse and logistics buildings. Companies or residential houses can utilise the use of solar power. It's estimated that an area of around 50 square meters is able to provide an output of 8 kWp. It requires 30 collector units and the cost will be about € 15,000. (Ruukki, 2014.)

7.3.21 Biomass power

Metso Company has an advanced automation technology use in the largest Asian biomass power plan of Dangjin in South Korea. Metso DNA is an automation and information platform for process control that combines machine, quality, supervisory, drive, optimizations and mechanical condition monitoring into a single platform using the Metso DNA Operate Remote Server which stores all the process pictures and Metso

DNA Operate Remote Client that can access these pictures offering remote users the ability to access the very same pictures and tools that are being used in the control room. Also information, tools, alarms, history functions, and reports that are in the control room can be shared using a laptop having a DNA client/server platform installed. (*Metso* Corporation, 2013.*)*

7.3.22 Air pollution

As part of the Beijing city's largest infrastructure investment is to replace coal-fired burners with natural gas for Beijing Heating system. This is run by Beijing District Largest Heating Company to improve the cities air quality by replacing its coal combustion with natural gas to reduce carbon-dioxide, nitrogen-dioxide emission and pollution caused by coal dust.

Oilon Company located in Lahti, Finland, specialises in heating and cooling systems using different energy sources as solar, oil and gas. It has supplied China with its high-tech burner technology of an innovative solution to solve the problem. (Oilon, 2015.)

7.3.23 Liquefied natural gas (LNG) solutions

The demand for natural gas is increasing rapidly because of its clean burning characteristics for producing electricity. The technique of LNG processing is to have the gas in its liquid form by cooling it -160°C (-260° F). At this temperature point the gas becomes a liquid where its volume reduces by a factor of more than 600 to ease the transportation process until it reaches its destination. Then it's converted back to natural gas. When it is needed it will be by warmed, then sent through pipelines for distribution. This freeing process can block some sections as impurities are found in raw gas and they freeze at low temperature. But Metso Company, headquarter in Helsinki, Finland, has different solutions for each LNG process before cooling and during the cooling stage by purifying and drying the gas before cooling it in cryogenic temperatures which are around (-238° F) to avoid freezing in the cold section of the process using molecular sieve method. Their technique is widely used within LNG industries because of their advanced technology.

The LNG cooling process using molecular sieving process is shown in Figure 4.

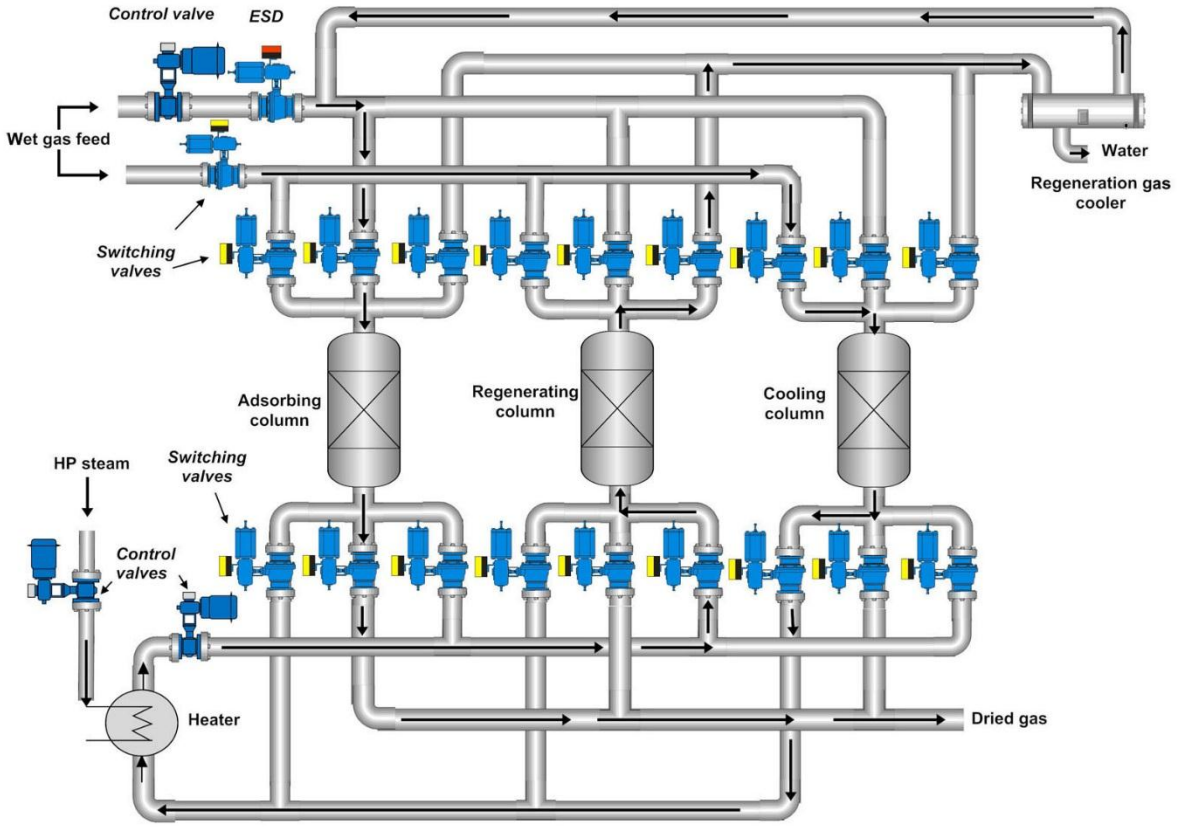

FIGURE 4. Visual representation of typical molecular sieving process. (Aronen, 2011)

7.4 Market entry

Finnish cleantech industries are in having the best time to respond to the global cleantech demands as the cluster is scoring good results as competitors in different occasions. The window of business opportunity is a short time period. Companies in the sector should position their targets for good deals available in Qatar's rising markets.

7.5 Suggestions

Finland is very well known as a country of qualified people, smart youth, and the best products, cleantech being one of the examples. This sector should benefit from the good image of the country by activating the marketing process and advertising its best products so as to be highlighted in the business headlines. The government and the companies should lead the business to the other world. Qatar is clearly focused on the best cleantech solutions available while Finland is rising within this technology. During my thesis work and experiences from my visits to Qatar I suggest that the best start up is to strengthen the official visits to Qatar. Companies should send trade representatives to Qatar for market research in different areas to advertise their products and technical

experts to seminars to explain the latest cleantech solutions. The Finnish education system is one of the best in the world and Qatar was realizing this opportunity by starting Qatar-Finland International School in September 2014 based on Finnish education practices. Other initiative is the cooperation between high education institutions by offering opportunities to Qatari students and teachers to study and practice in Finland. During my research work I was able to visit some companies and institutions which are very interested in cooperation and doing business in the cleantech sector. My plan is to continue this research and transform it into a market research reference including companies, contacts and consultation for marketing Finland cleantech solutions to Qatar.

8 CONCLUSION

The main objective of the thesis was to study the possibilities to promote Finland cleantech industry and create business opportunity for Finnish companies to present their different cleantech solutions in Qatar for the 2022 FIFA World Cup and beyond. The purpose was not only creating profits but Finland cleantech ranked as top and awarded among the first stagers in many occasions is ready to export its state of the art cleantech technologies and share experiences. Qatar is seeking cutting edge sustainable and advanced cleantech solutions available to be adopted for the 2022 FIFA World Cup as promised to build environmentally friendly world cup venues and sport stadiums then link the developments with its 2030 national vision planning.

After intensive research, the results of this work are shared to show some of the Finnish cleantech which are becoming very advanced in different areas and involving in many environmental solutions not only in Finland but globally.. The sector is having a full public support and generous government funding for education and research. The sector has gained good exporting opportunities in Europe, US and China, and seeking other opportunities within the global market. Qatar has an appeal for the best technology available and has reserved a huge budget for investment in the sector. According to this study on the environmental XPRT webpage as a leading B2B marketplace holding information for over 44,000 environmental companies, from 735 clean technology investments companies in Qatar there are only 5 companies (Fortum, Neste Oil, Gasmet Technologies, Lamor Corporation AB and Finnchain Oy) from Finland that are registered in this site and are active within the same market of oil and gas. (Environmental XPRT, 2015.) The government of Finland has good strategies to promote cleantech industry followed by extensive official visits. One example was the business delegation visit led by former Prime Minister Jyrki Katainen joined with some ministers and business men to Qatar and the United Arab Emirates on 2-7 March 2013 (Finnish expertise showcased during visit to the Gulf area, 2013.) There are many companies operating within the domestic market but slowly moving to the global market due to lack of networking or spending a lot of time in assessment to avoid risk, although it is minimum because cleantech is a necessity today and a guaranty to deliver quality services. Qatar is appealing for best cleantech technologies. The country is responding very fast and is eager to initiate communication especially in renewable energies and energy efficiency as the fastest growing market while the 2022 FIFA World Cup arrangement has created a huge need for waste management, water treatment, Eco-buildings and air-cooling products and services. As the country is rich and ready for investment there is big

competition but the best quality cleantech solutions are in high demand and ready to win grounds, if companies are ready to share experiences and offer technology transfer to the country. The investment opportunity available can be through government to government which are huge projects, a company to company for big or medium size activities, and person to person which involved small activities like household waste management investment. The two countries are both active in cleantech innovativeness while Qatar is rich and ready to transform itself as an advanced country benefiting from its wealth, Finland has the technology, good education, and good human resource asset. Qatar ambitions and readiness to invest in best cleantech solutions and Finland know-how is a best match to produce a success story. Finland cleantech industry has a good reputation of quality product and services which have been deployed as good solutions in different environmental areas some of the examples have been highlighted in chapter 7. For Qatar case there are some efforts needed to help strengthening the networking within Qatar and Finland to be able to expand the investment opportunities by exploring methods to help in reaching decision makers, creating channels for connections and building trusted relations. Finland cleantech is able to has a positive influence benefiting from its confidence which has been created within the global market.

During this thesis's research I have gained some experience and knowledge which I would like to use by involving in more engaged research work with one of the four (Helsinki, Oulu, Kuopio and Lahti) expertise of Finnish cleantech cluster where the best Finland cleantech solutions are reflected are liaised by Finpro as business facilitator. The company helps Cleantech Finland to build solid business network, strengthen relations and ease communications. Also I would like to be involved in different cleantech research projects within different Finnish higher institutions where is possible to share ideas between the researchers from Finland and Qatar to strengthen the cooperation in cleantech sector between the two countries.

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